Convegno finale progetto INHABIT

Habitat e stato ecologico: risposta biologica a possibili misure di ripristino in fiumi e laghi italiani

29 ottobre 2013

CNR, Via Bassini 15, Milano

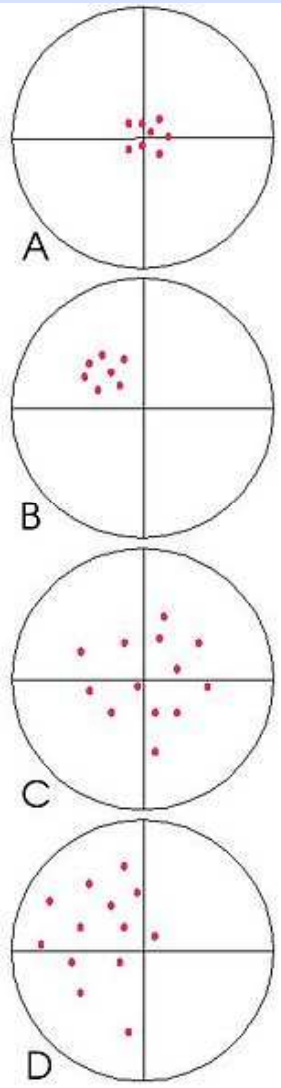
Aula Convegni

Invertebrati bentonici e carattere lentico-lotico dei fiumi: incertezza nella classificazione, accuratezza e valutazione dello stato ecologico

CNR-IRSA, RAS, ARPA Piemonte

A. Buffagni, S. Erba, R. Balestrini, M. Cazzola, C. Belfiore, R. Tenchini, G. Pace, D. Armanini, G. Dörflinger, E. Sesia, A. Fiorenza, T. Ferrero, R. Casula, G. Erbì, M. Pintus, G.M. Mulas, R. Pagnotta

REGIONE AUTONOMA DELLA SARDEGNA



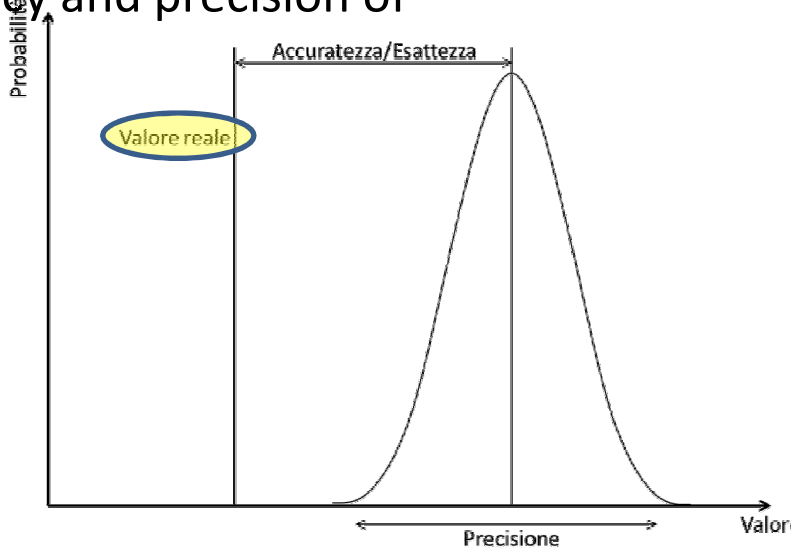
WFD: uncertainty in estimating Ecological Status: what is really relevant?

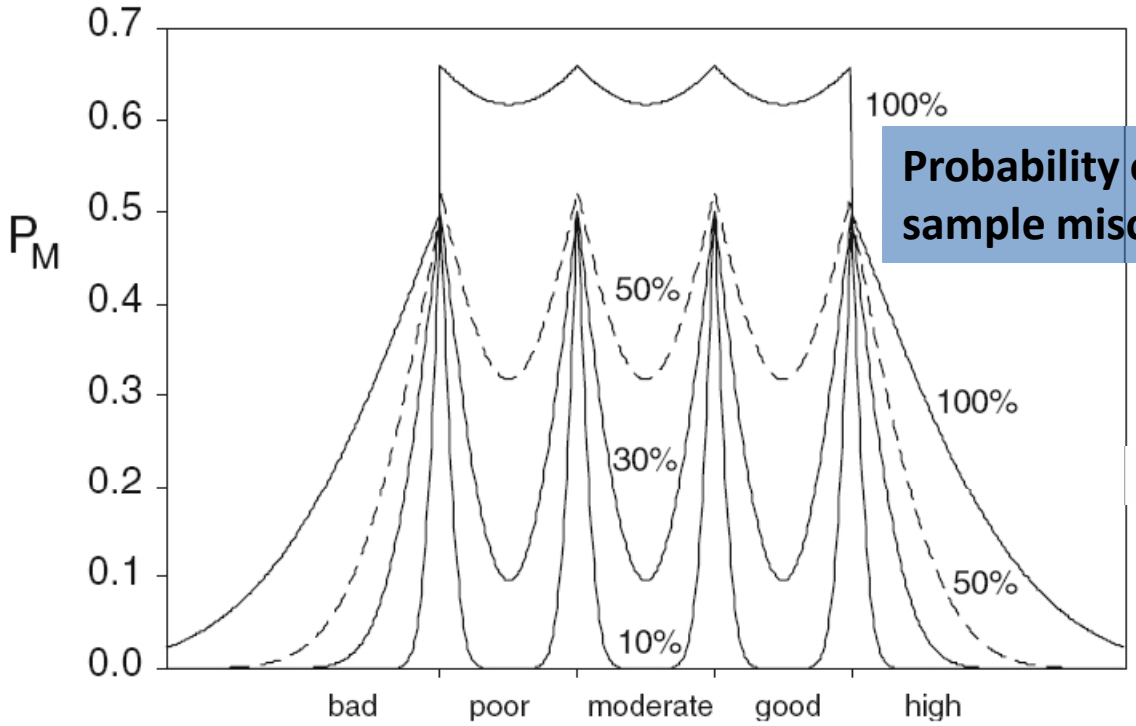
What about 'uncertainty' in defining reference conditions??

A conceptual example of accuracy and precision of a series of data (red dots).

A- Precise and accurate
B- Precise but not accurate
C- Accurate but imprecise
D- Not accurate nor precise

http://it.wikipedia.org/wiki/File:Accuracy_and_precision_example.jpg





Probability of sample misclassification

Clarke & Hering. 2006. Hydrobiologia 566:433–439

Figure 1. Plot of the probability (P_M) of classifying a site into a different status class versus its true Environmental Quality Ratio (EQR) value for a range of error/uncertainty standard deviations (σ) in the observed sample EQR value. The EQR range has been divided into the five WFD classes (high, good, moderate, poor and bad) with the middle three classes each of width W. Plots are shown for $\sigma = 10$, 30, 50 and 100% of W, where the broken line indicates the 50% plot.

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PRECISIONE – caratteristica del metodo di misura

grado di concordanza tra risultati di prova indipendenti ottenuti nelle condizioni stabilite (Ellison et al., 2000; ISS, 2000)

Clarke, 2004 - per metriche biologiche:

Incertezza nelle condizioni di riferimento

RefCondUncertainty=DEV.ST(REF_samples)/(RADQ(n_REF_samples))

Incertezza stimata sulla totalità di campioni raccolti

Sampling SD=(RADQ(**0.223***(DEV.ST(ALL_samples)^2)))

0.223: valore medio da letteratura
intersample variability/trattamento del campione

CLARKE R. T., 2004. Error/Uncertainty module software STARBUGS - STAR Bioassessment Uncertainty Guidance Software. (Paper version of User Manual). 39pp.

ELLISON S. L. R., ROSSLEIN M. & WILLIAMS A. (Ed), 2000. Quantifying Uncertainty in Analytical Measurement. Second Edition. EURACHEM/CITAC Guide CG 4, 126 pp.

ISS, 2000. Quantificazione dell'incertezza nelle misure analitiche. Istituto Superiore di Sanità. Seconda edizione (2000) della Guida EURACHEM/CITAC CG 4, 128 pp.

Risultati coefficienti di variazione
>20 tipi fluviali considerati: Italia (nord, centro, sud, Sardegna) & Cipro

Media Sampling SD: **0.0867 ± 0.0295**

Media Refcond Uncert: **0.0259 ± 0.0071**

Valori Sampling SD indicativi **dataset europei, varie metriche**: **0.01 - 1**
Clarke et al., 2006

Macrotipi fluviali (in accordo con DM 260/2010)

Macrotipo	Mesohabitat	Sampling SD	RefCond Uncert	#campioni tot	#siti ref	#campioni ref
A1 - calcareo[1]	Generico	**0.0490**	**0.0387**	16	4	9
A2 - siliceo	Generico	0.0761	0.0239	620	32	149
C	Generico	**0.1620**	0.0257	168	6	26
M1	Pool	0.0855	0.0238	66	7	20
	Riffle	0.0821	0.0315	82	8	22
M2[2]	Pool	0.0818	0.0278	96	10	28
	Riffle	0.0731	0.0278	112	11	30
M3[3]	Art	0.1011	**0.0142**	228	-	20
M4	Pool	0.0551	0.0205	30	3	8
	Riffle	0.0744	0.0360	30	3	8
M5	Pool	0.1011	0.0353	141	-	43
	Riffle	0.0931	0.0249	71	15	21

[1] per macrotipo A1 - Area alpina geologia calcarea: valori indicativi calcolati su un limitato numero di campioni.
[2] per macrotipo M2: dati non disponibili, valori calcolati come media dei valori dei macrotipi mediterranei M1 e M4.
[3] per macrotipo M3: grandi fiumi, valori relativi al fiume Po, campionamento effettuato mediante substrati artificiali.

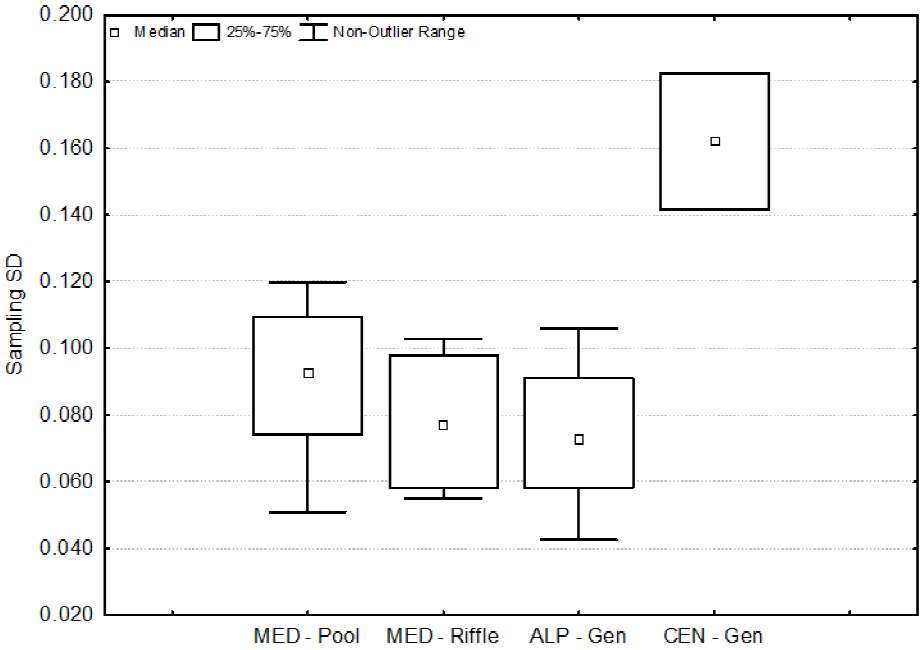
CLARKE R. T., LORENZ A., SANDIN L., SCHMIDT-KLOIBER A., STRACKBEIN J., KNEEBONE N. T. & HAASE P., 2006. Effects of sampling and sub-sampling variation using the STAR-AQEM sampling protocol on the precision of macroinvertebrate metrics. Hydrobiologia 566: 441-459.

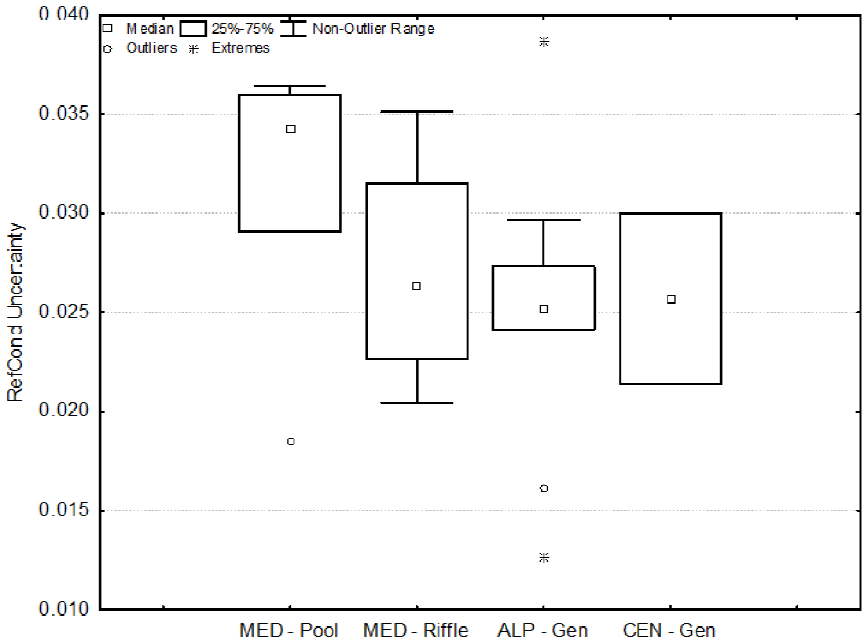
REGIONE AUTONOMA DELLA SARDEGNA

Distribuzione valori coefficienti

variazione dei campioni complessivi e **incertezza delle condizioni di riferimento**

Per MACROAREE





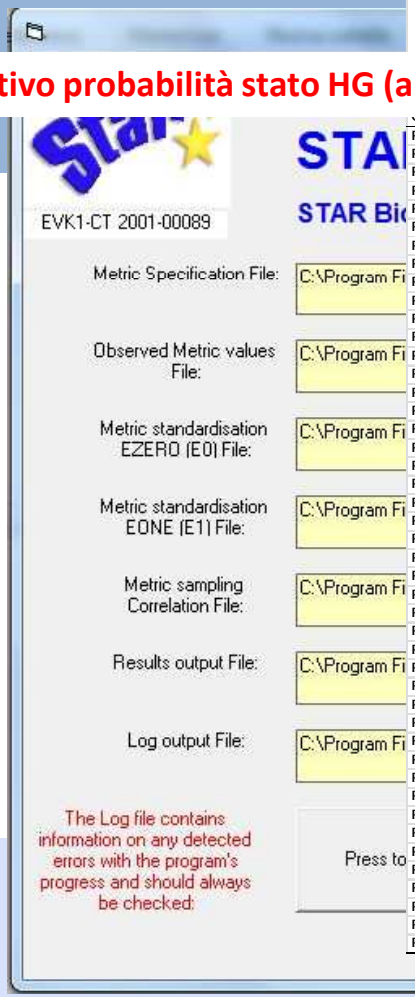
Da Coefficienti di variazione:

Calcolo dell'incertezza nelle stime della classe di qualità:

Percentuale classi di stato

Piemonte, 06SS2

livello cumulativo probabilità stato HG (alto: >75%, medio: 75-40%, basso: <40%)



Cod. Stazione	data								livello di probabilità stato buono elevato MMI
P06SS2_457	13/02/2009	0.636	3	1.4	26.5	58.4	13.6	0.2	**27.9** basso
P06SS2_458	19/05/2009	0.748	2	7.1	50.4	39.6	2.9	0	**57.5** medio
P06SS2_459	22/09/2009	0.712	3	4.6	42.7	47.7	5	0.1	**47.3** medio
P06SS2_460	30/07/2009	0.392	4	0	0.9	26	59	14.1	**0.9** basso
P06SS2_461	23/10/2009	0.48	3	0.1	4.5	46.5	44.4	4.5	**4.6** basso
P06SS2_462	11/02/2009	0.883	2	29.5	57.1	13.2	0.2	0	**86.6** alto
P06SS2_463	14/05/2009	0.792	2	12.3	57.2	29	1.6	0	**69.5** medio
P06SS2_464	03/09/2009	0.971	1	53.5	42.7	3.8	0.1	0	**96.2** alto
P06SS2_465	05/06/2009	0.112	5	0	0	0.4	17.6	82	**0** basso
P06SS2_466	05/10/2009	0.11	5	0	0	0.5	18	81.5	**0** basso
P06SS2_473	08/05/2009	0.681	3	2.5	36.4	52.8	8.1	0.2	**38.9** basso
P06SS2_474	09/05/2009	0.754	2	7.4	51.8	38	2.7	0	**59.2** medio
P06SS2_475	17/07/2009	0.752	2	7.4	51.1	38.8	2.7	0	**58.5** medio
P06SS2_476	17/07/2009	0.863	2	24.9	59.7	15.1	0.3	0	**84.6** alto
P06SS2_477	17/11/2009	0.65	3	1.8	29.5	57	11.5	0.2	**31.3** basso
P06SS2_517	06/02/2009	0.192	5	0	0	2	33.9	64.1	**0** basso
P06SS2_518	14/05/2009	0.304	4	0	0.2	10.6	56.4	32.8	**0.2** basso
P06SS2_519	28/09/2009	0.261	4	0	0.1	6.1	50.3	43.5	**0.1** basso
P06SS2_535	10/04/2009	0.599	3	0.7	19.7	59.4	19.6	0.7	**20.4** basso
P06SS2_536	05/06/2009	0.481	3	0.1	4.6	45.1	45.8	4.5	**4.7** basso
P06SS2_537	10/09/2009	0.513	3	0.1	7.2	51.3	38.8	2.6	**7.3** basso
P06SS2_538	08/04/2009	0.349	4	0	0.5	17.9	59.7	21.9	**0.5** basso
P06SS2_539	01/07/2009	0.343	4	0	0.4	17.1	59.6	23	**0.4** basso
P06SS2_540	14/10/2009	0.631	3	1.2	25	59.8	13.7	0.3	**26.2** basso
P06SS2_478	27/01/2010	0.932	2	43.1	49.6	7.3	0.1	0	**92.7** alto
P06SS2_479	02/07/2010	0.839	2	20.1	59.2	20.2	0.6	0	**79.3** alto
P06SS2_480	21/09/2010	0.98	1	55.9	40.5	3.6	0	0	**96.4** alto
P06SS2_481	26/02/2010	0.455	4	0	3.2	40.1	50.5	6.2	**3.2** basso
P06SS2_482	11/06/2010	0.48	3	0	4.6	44.3	46.5	4.5	**4.6** basso
P06SS2_483	16/09/2010	0.643	3	1.5	28.1	57.4	12.8	0.2	**29.6** basso
P06SS2_484	12/02/2010	0.837	2	19.2	60.6	19.6	0.6	0	**79.8** alto
P06SS2_485	23/06/2010	0.911	2	36.8	54	9.2	0.1	0	**90.8** alto
P06SS2_486	20/09/2010	0.952	2	47.6	47.3	5	0	0	**94.9** alto
P06SS2_493	17/03/2010	0.882	2	29.2	58.2	12.5	0.2	0	**87.4** alto
P06SS2_495	24/06/2010	0.815	2	16.1	58.2	24.9	0.9	0	**74.3** medio
P06SS2_497	14/10/2010	1.013	1	64.3	33.7	2	0	0	**98** alto
P06SS2_494	17/03/2010	0.998	1	60.7	36.5	2.8	0	0	**97.2** alto
P06SS2_496	24/06/2010	0.71	3	4.2	42.7	47.9	5.1	0	**46.9** medio
P06SS2_498	14/10/2010	0.989	1	57.5	39.2	3.2	0	0	**96.7** alto
P06SS2_501	03/02/2010	0.034	5	0	0	0.1	7.1	92.8	**0** basso
P06SS2_502	28/05/2010	0.045	5	0	0	0.1	8.4	91.5	**0** basso
P06SS2_503	22/09/2010	0.216	5	0	0	3.1	39.9	57	**0** basso
P06SS2_504	03/03/2010	0.47	4	0	4	43.6	47.8	4.7	**4** basso
P06SS2_505	02/08/2010	0.369	4	0	0.8	21	59.9	18.4	**0.8** basso
P06SS2_506	12/11/2010	0.553	3	0.3	11.5	58	29.1	1.2	**11.8** basso

Software 'STARBUGS 1.2'

(Clarke, 2005)

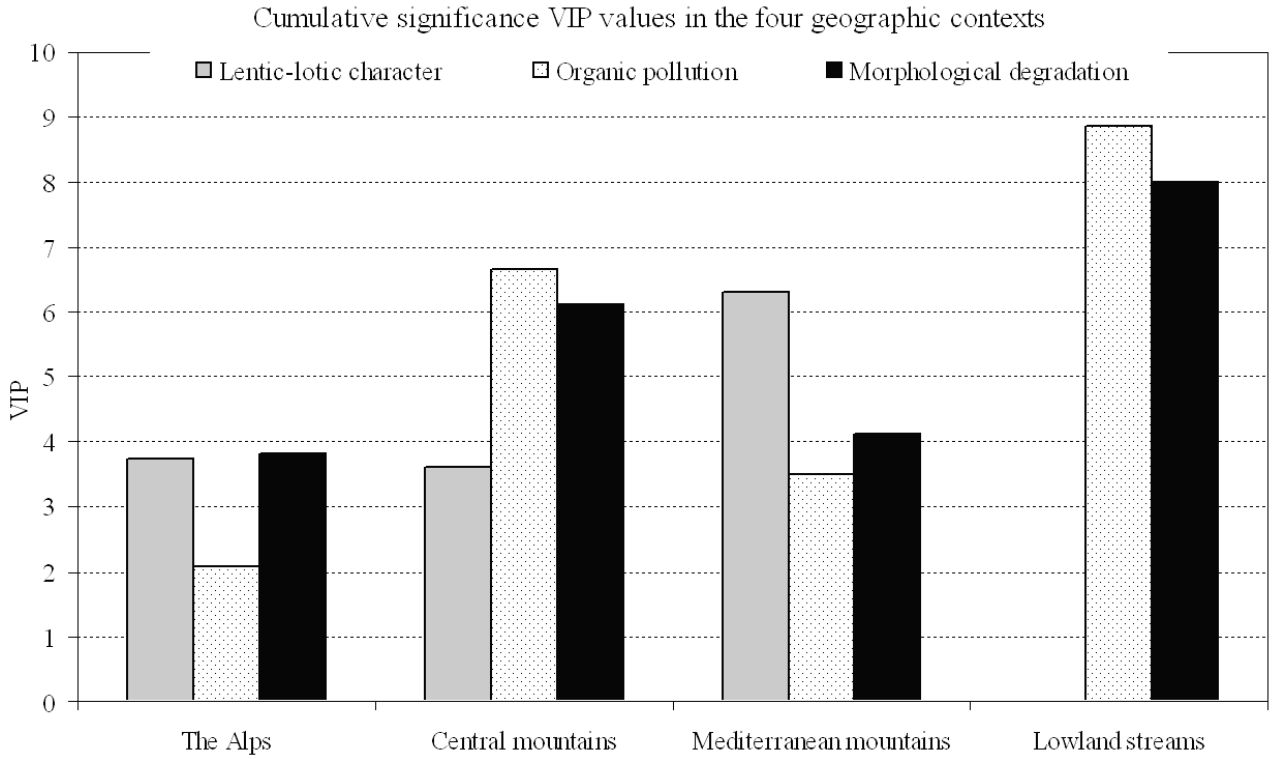
- **Piemonte - 01SS2**
- **Piemonte - 06SS2**
- **Sardegna**
- **Alto Adige 03SS**

CLARKE R. T., 2005. STARBUGS (STAR Bioassessment Uncertainty Guidance Software). Release 1.2 (July 2005).

Habitat information for Ecological status: is that useful??

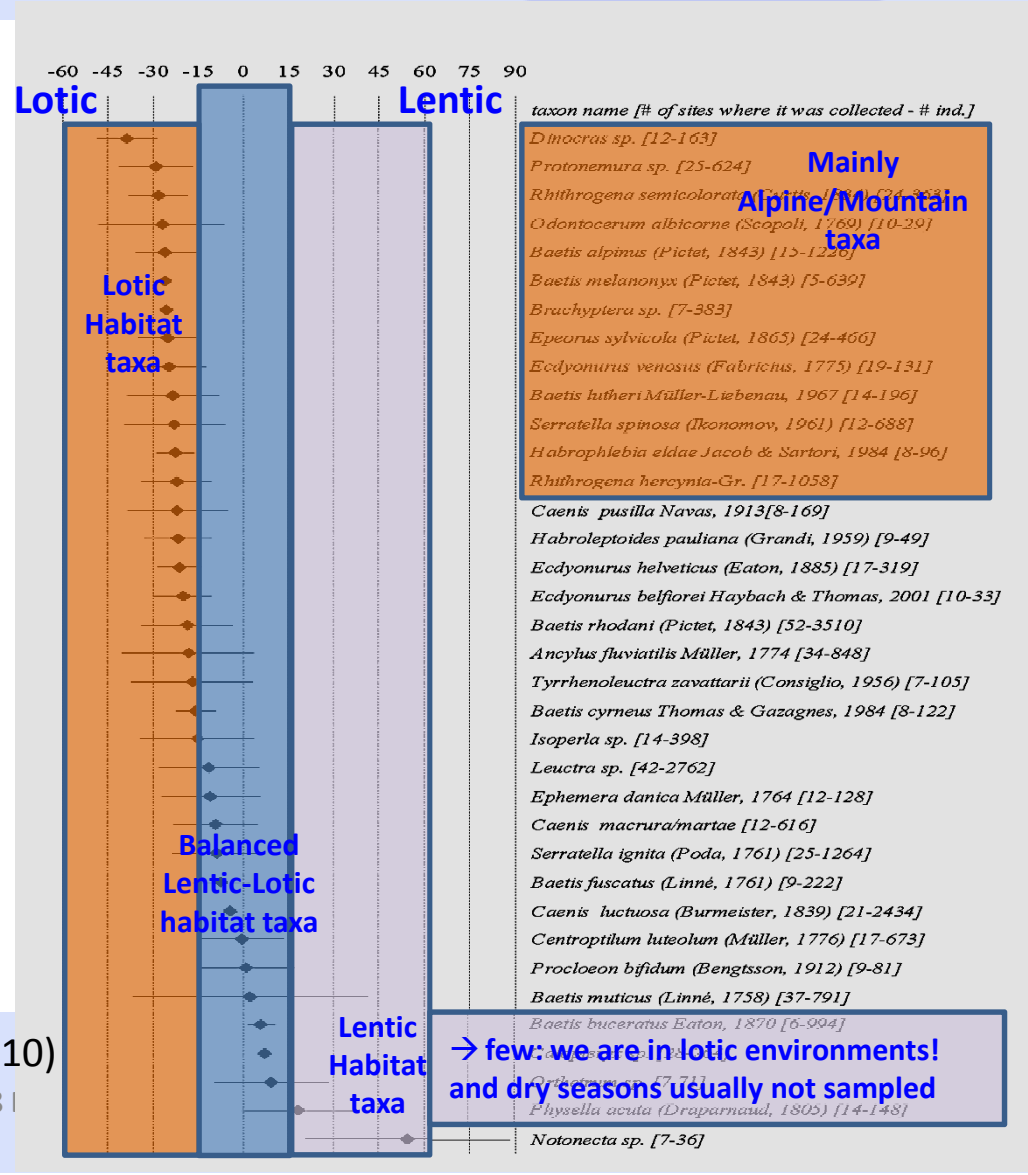
INHABIT: the main theme

- Relative importance of different pressures (stressors) in European rivers
- HMS: Morphological degradation; OPD: Physiochemical pollution
- The contribution of the Lentic-lotic River Descriptor (LRD)



Buffagni A., Erba S. & Armanini D.G. 2010. The lentic–lotic character of Mediterranean rivers and its importance to aquatic invertebrate communities *Aquatic sciences*.

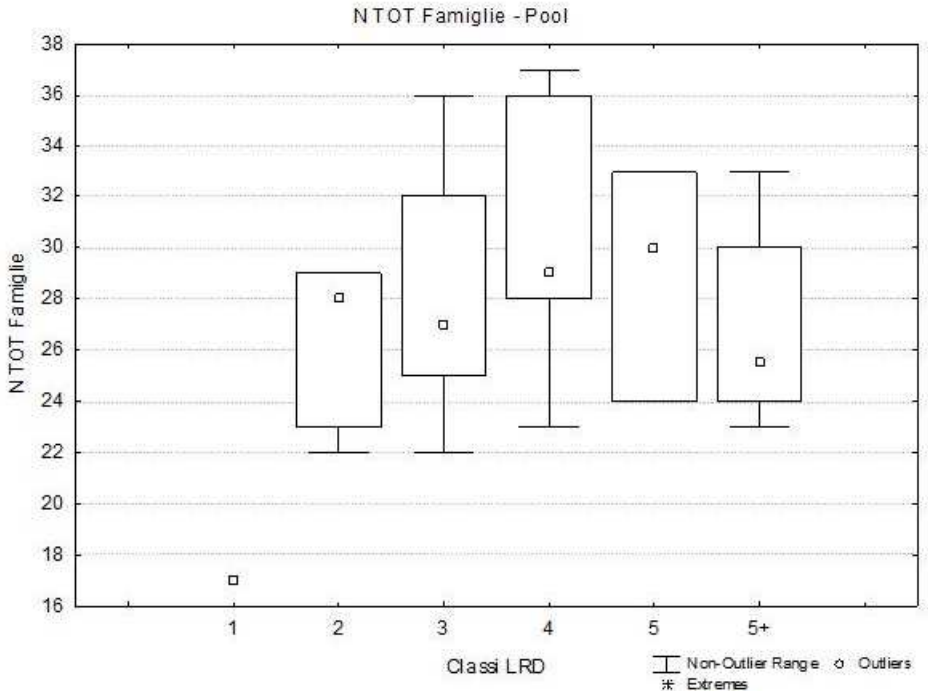
Response of invertebrate taxa to the lentic-lotic character - LRD

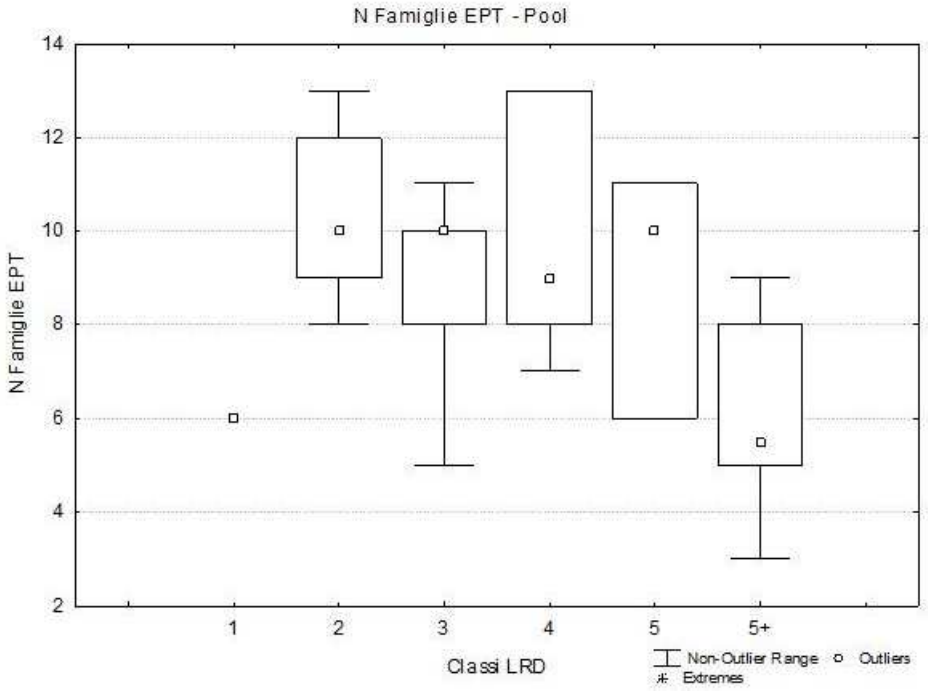


(from Buffagni et al., 2010)

The contribution of Habitat-oriented methods
Quantifying natural variability

Assessment of natural variability (only REF/sligthly perturbed sites), benthic metrics
Sardinia Med rivers

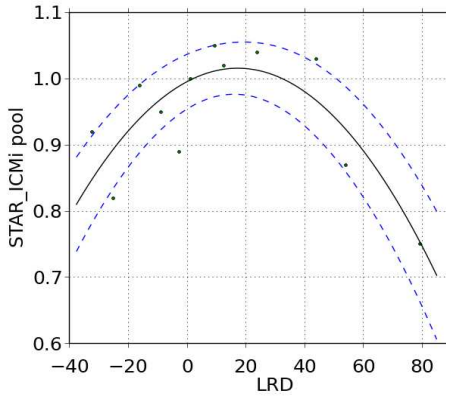


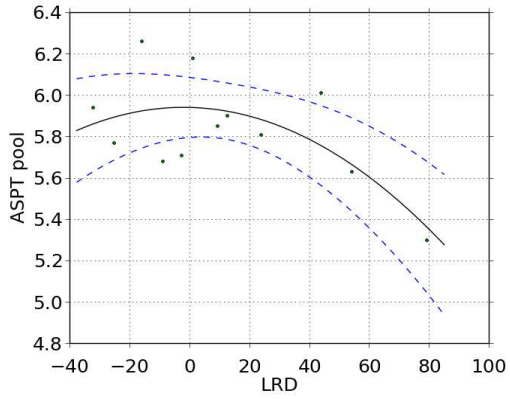


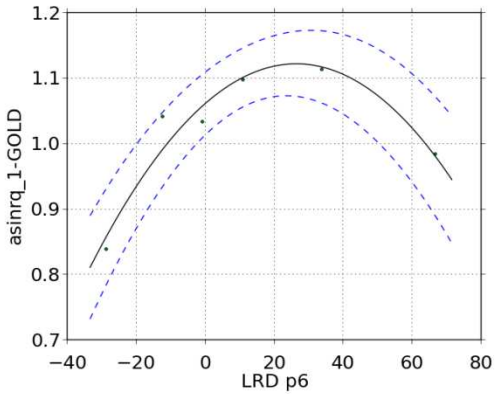
Influence of habitat on invertebrate metrics:

LRD (river stretch)

			STAR_ICMi	ASPT	n_FAM[2]	n_EPT[2]	1-GOLD[3]	Shannon	log(SelEPTD+1)
			n samples/group=6						
'Pool' mesohabitat / Sardinia REF&slightly perturbed sites (REF RAS)		STAR_ICMi	0.048	**0.017**	0.045	**0.003**	**0.020**	0.342	**0.060**
			*	*	*	***	*	NS	(*)
			9.9	**20.9**	10.3	**71.6**	**19.1**	1.6	**8.3**
		all samples (n=36)	0.78	0.89	0.79	0.97	0.88	0.18	0.74
			-3.2	-2.4	-1.1	-2.9	-3.6	-1.1	-1.5
			3.1	8.7	9.2	24.5	5.3	1.5	5.6
LRD[1] (Reach scale, 500 m)	p	0.025	**0.006**	0.066	**0.002**	0.006	0.223	0.319	0.222
	sl	*	**	(*)	***	**	NS	NS	NS
	F	4.1	**9.8**	3.7	**14.3**	9.8	1.8	1.3	1.8
								.05	0.12
								0.4	-0.1
								3.5	29.9



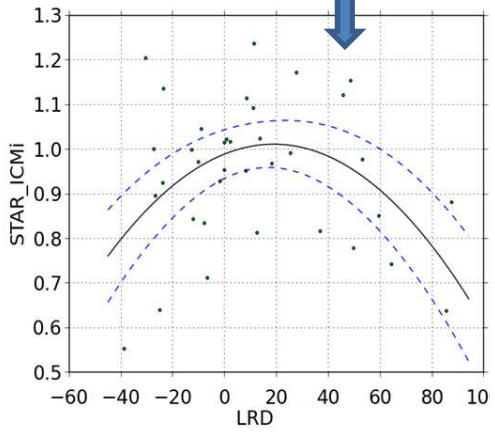


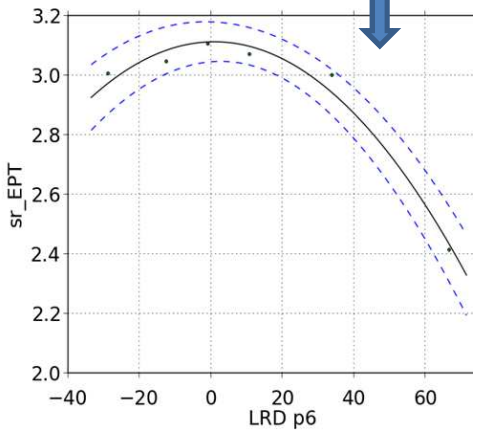


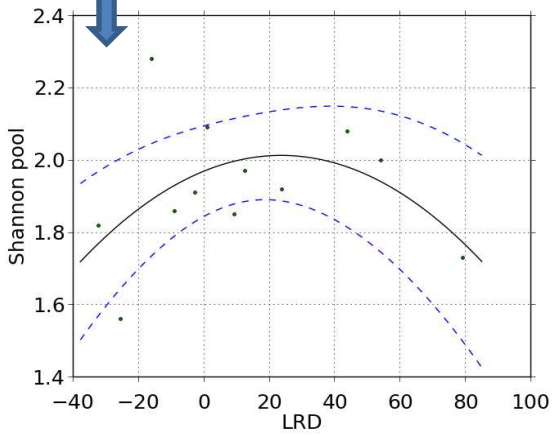
REGIONE AUTONOMA DELLA SARDEGNA

Habitat control on biota: Lentic-Lotic character - Summary

'Pool' mesohabitat / Sardinia REF&slightly perturbed sites		STAR_ICMi	STAR_ICMi	ASPT	sr_FAM	sr_EPT	arcsinsr_1-GOLD	Shannon	log(SelEPTD+1)
		all samples						NS	
LRD (Reach scale, 500 m)	p	0.025	**0.006**	**0.017**	**0.002**	**0.003**	**0.020**	0.319	**0.060**
	sl	*	**	*	***	***	*	NS	(*)
	F	4.1	**9.8**	**20.9**	**14.3**	**71.6**	**19.1**	1.3	**8.3**
	R-sq adj	0.15	0.61	0.89	0.71	0.97	0.88	0.05	0.74
	AIC	-0.9	-2.6	-2.4	-0.7	-2.9	-3.6	-0.4	-1.5
	F/ass_AIC	4.8	3.8	8.7	19.4	24.5	5.3	3.5	5.6

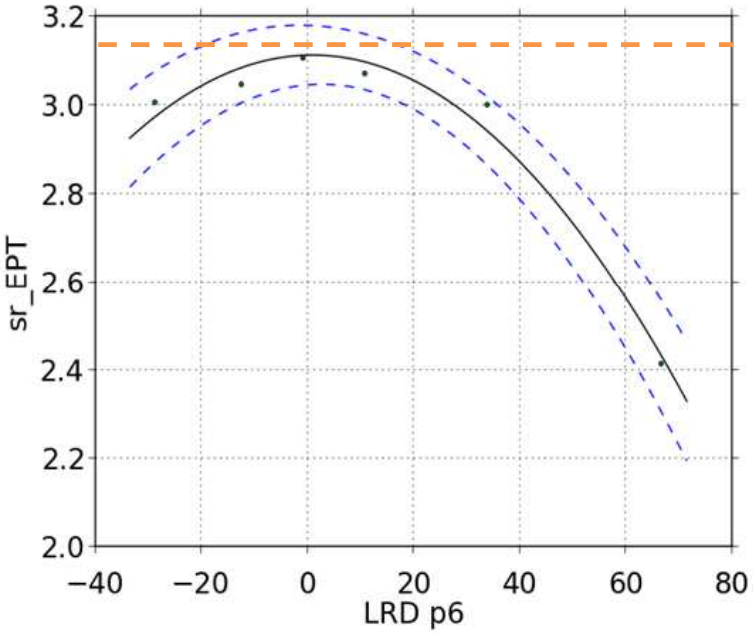




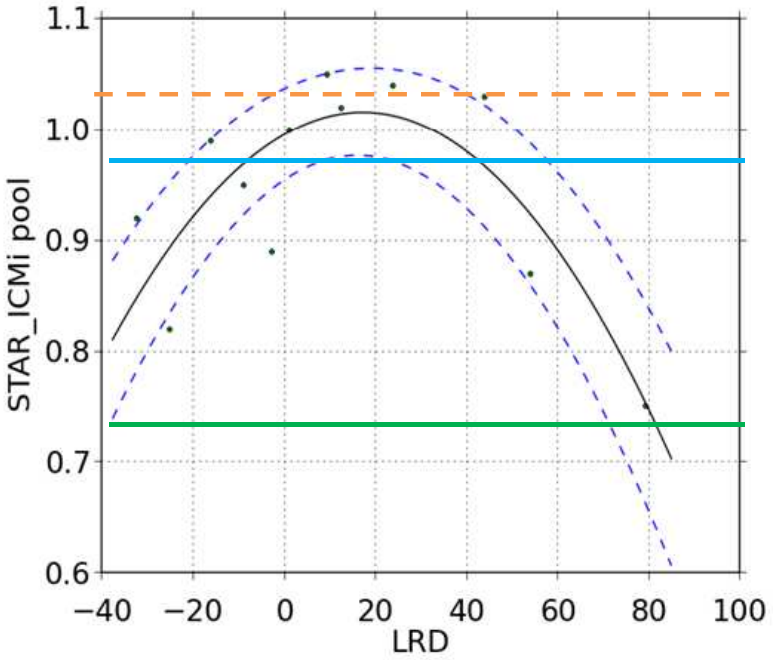


What about accuracy in Ecological Status classification ??

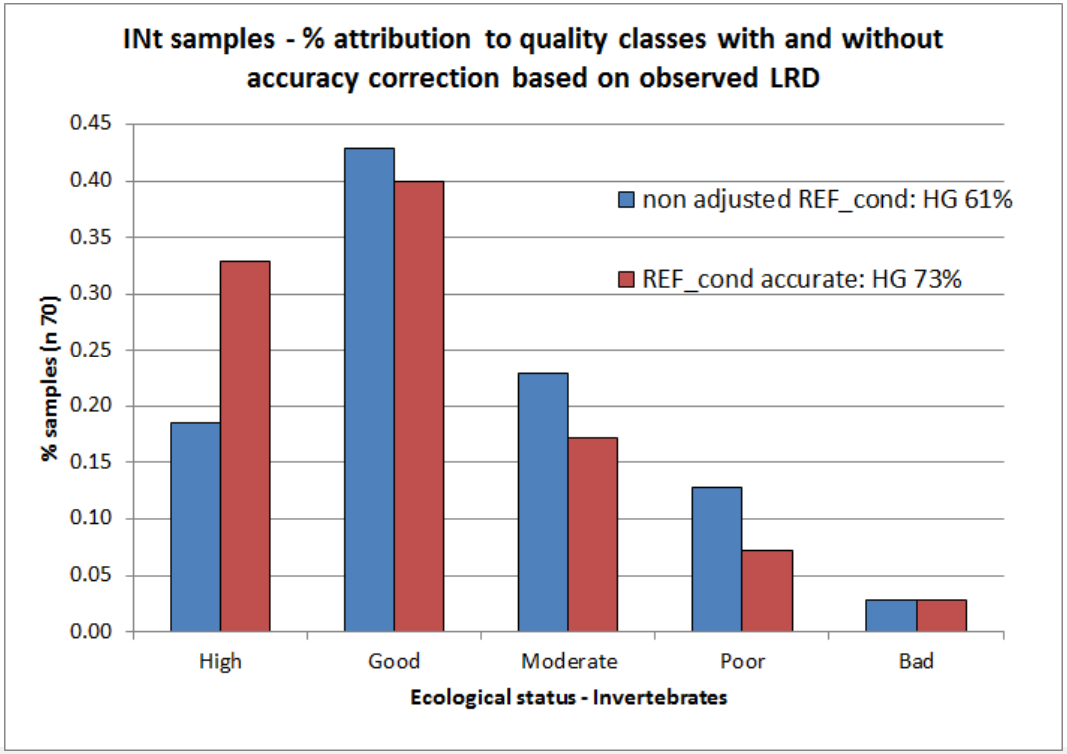
REF value
EPT: 10 (3.16 [2])
STAR_ICMi: 1.019



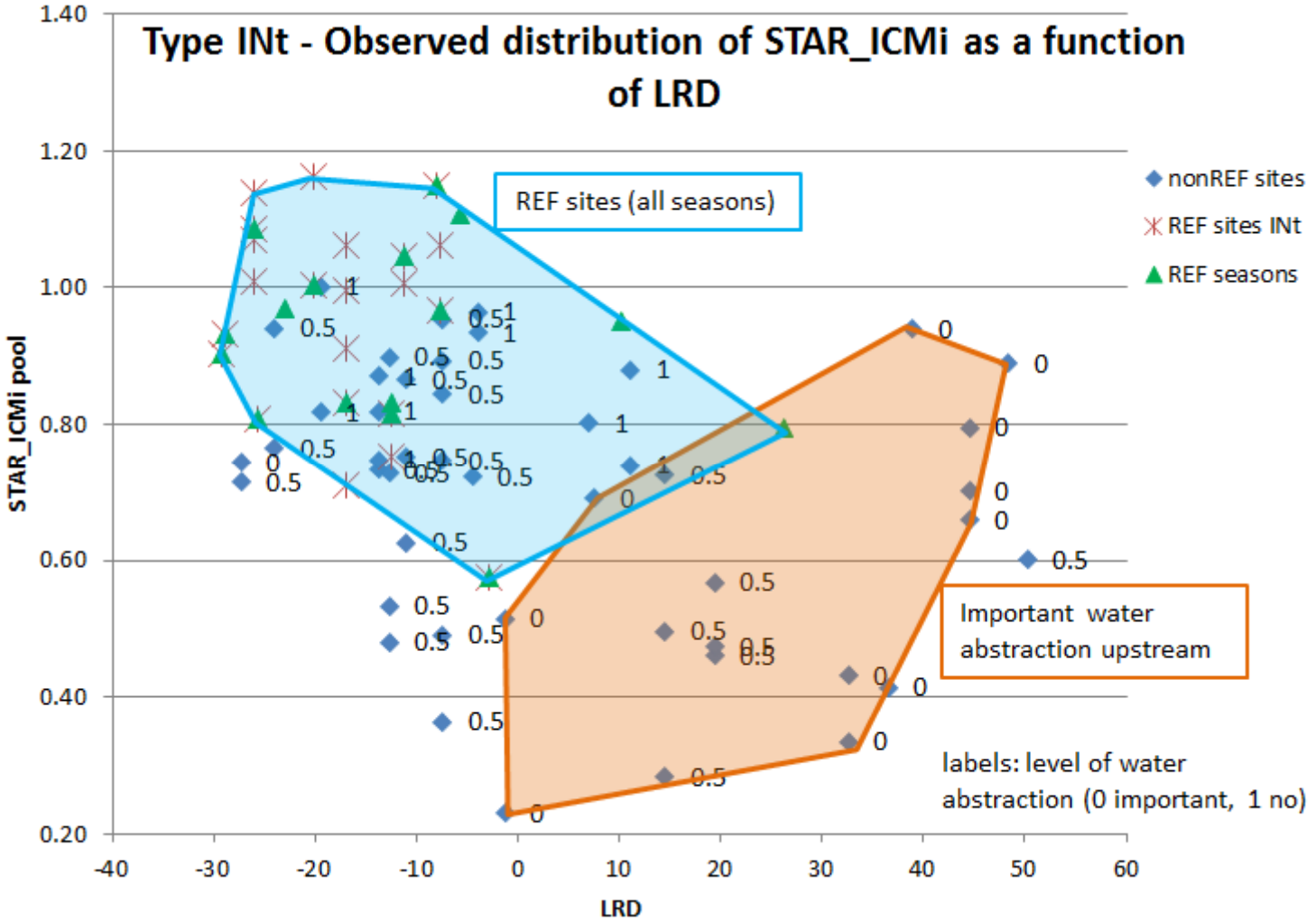
Class boundaries (Italy – R-M5)
HG: 0.97
GM: 0.73



Modifica livello probabilità attribuzione classi dopo affinamento condizioni di riferimento (correzione accuratezza su habitat - LRD)



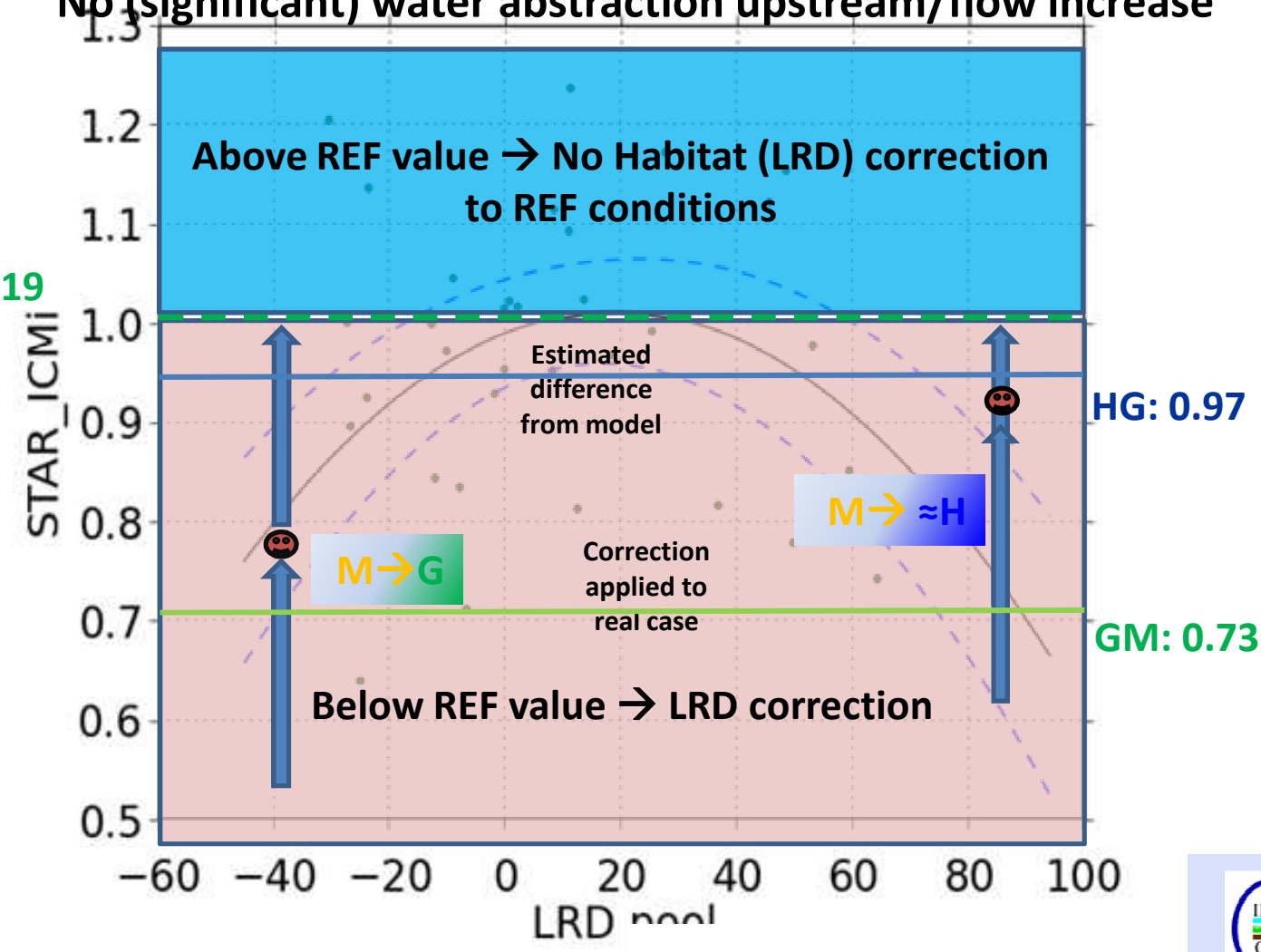
Proportion of samples allocated to each Ecological Status class for sites of the INt type. Results are shown both for the 'rough' classification (i.e. overall, single value reference conditions) and 'accuracy-corrected' (i.e. reference conditions as before as a starting point and then reckoned by looking at the lentic-lotic conditions observed at the site when sampling).


Type INt - Observed distribution of STAR_ICMi as a function of LRD
STAR_ICMi pool
LRD
REF sites (all seasons)
nonREF sites
REF sites INt
REF seasons
Important water abstraction upstream
labels: level of water abstraction (0 important, 1 no)

Direct use of Habitat information
Modeling reference conditions

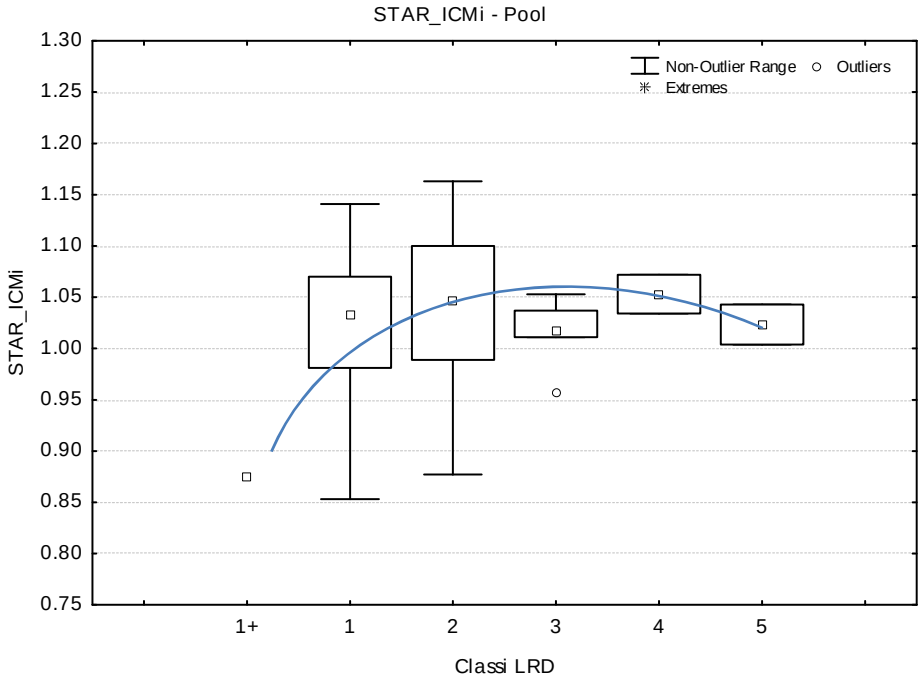
No (significant) water abstraction upstream/flow increase

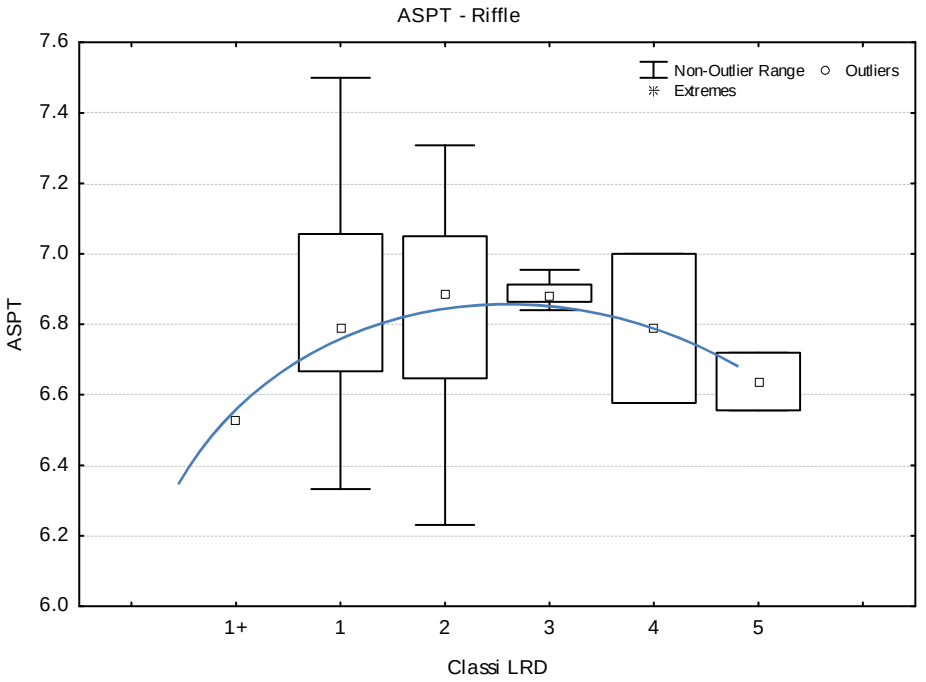
REF value
STAR_ICMi: 1.019

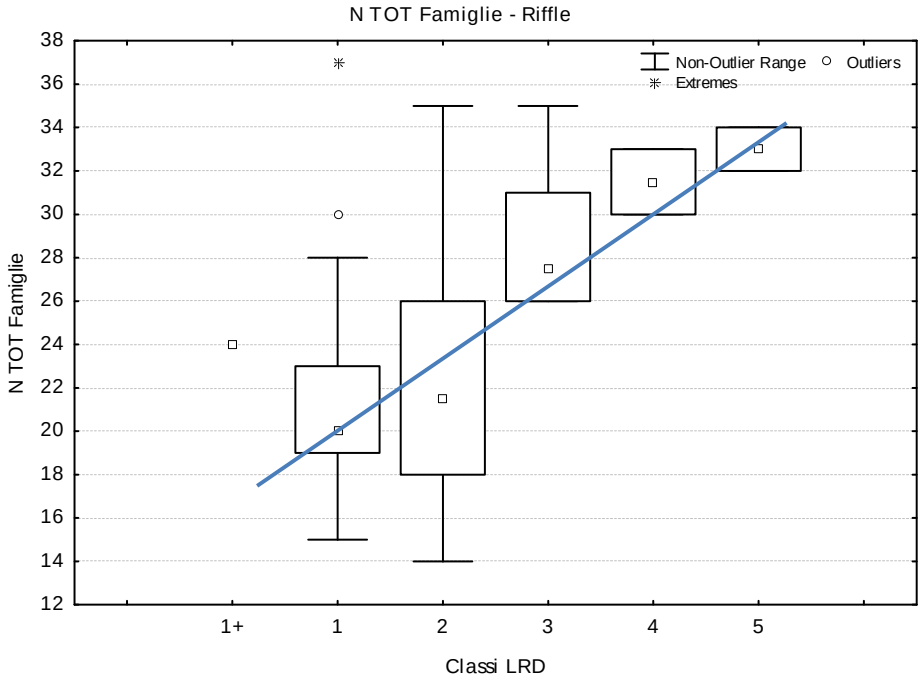


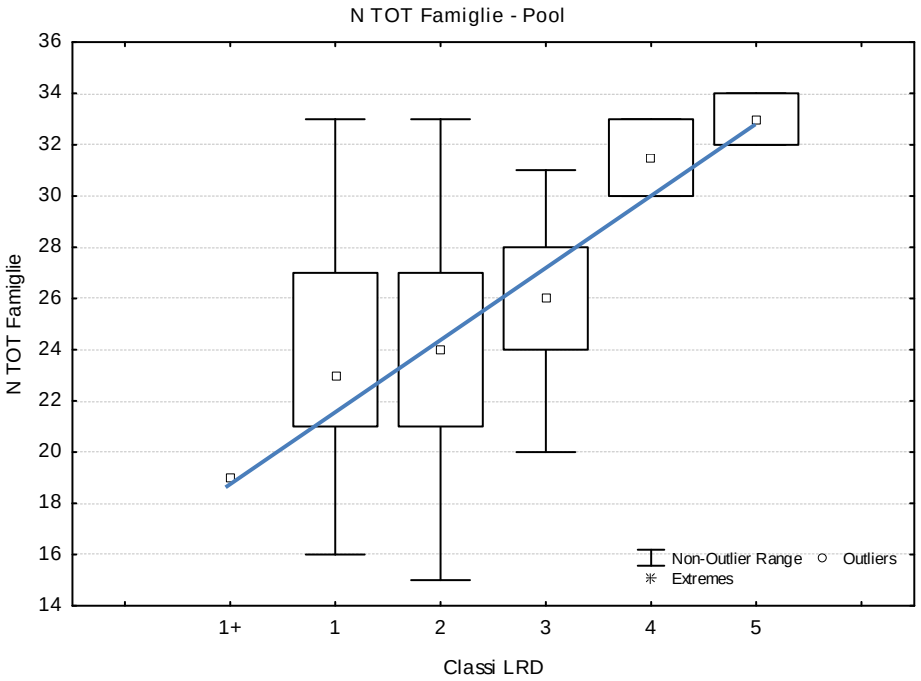
e.g. different sites in the same area, type, season, year

Fiumi non mediterranei (Piemonte): è tutto diverso?






N TOT Famiglie - Riffle
Non-Outlier Range
Outliers
Extremes
N TOT Famiglie
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1+
1
2
3
4
5
Classi LRD


N TOT Famiglie - Pool
N TOT Famiglie
36
34
32
30
28
26
24
22
20
18
16
14
Non-Outlier Range
Outliers
Extremes
1+
1
2
3
4
5
Classi LRD

Alcune conclusioni di INHABIT – aspetti Habitat/biota e classificazione

- **L'incertezza della classificazione legata alla precisione della misura può essere facilmente quantificata → gli effetti attesi sulla classificazione finale sono nell'ordine del ± 10%**
- **Esiste un'importante influenza delle caratteristiche di habitat sulle comunità.**
- **Il carattere lentico-lotico è direttamente correlato alla variabilità delle metriche biologiche e influenza gli indici biologici utilizzati nella classificazione.**
- **L'accuratezza complessiva dei metodi di classificazione in uso può quindi essere scarsa → È opportuna una correzione nei sistemi di classificazione sulla base delle caratteristiche di habitat: è possibile definire semplici relazioni tra LRD e metriche biologiche.**
- **Le caratteristiche di habitat saranno da considerare per la ridefinizione delle condizioni di riferimento → i.e. RefCond Tipo+Sito specifiche**
- **'Correzione di accuratezza' → effetti sulla classificazione finale fino a + 30%**


Grazie per l'attenzione!!
Milano, 29 ottobre 2013